Neologisms with Birth-Certificates. Case of Mineralogical Nomenclature

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Abstract The article focuses on the recently added items in mineralogical nomenclature, which constitutes an important part of the terminology of this field. Analysis of a sample of the mineral names adopted by the Commission on New Minerals, Nomenclature and Classification of the International Mineralogical Association in 2022–2023 showed that (a) mineralogical nomenclature represents a hybrid set of names formed by prefixation, suffixation, chemical and physical descriptive names, and names based on onomastic metonymies; (b) despite objections formulated by terminologists and mineralogists, this nomenclature remains predominantly based on proper names of persons and places; (c) other types of names, as names referring to chemical and structural properties of minerals, are relatively rare (even if many names formed from proper names contain affixes referring to the chemical and structural properties of minerals); and (d) metaphors are relatively rarely used to form new names of minerals, although they are very frequent in trivial names of minerals.

Keywords metaphor, metonymy, mineralogy, names, nomenclature, term, terminology

1 Introduction

Mineralogy is one of the oldest branches of science. Let us only think of the several volumes on earths, metals, stones, and gems of Pliny the Elder's *Naturalis Historia* (1st century), *Book XVI* on stones and metals of *The Etymologies* by Isidore of Seville (6th–7th century), medieval lapidaries devoted to the medicinal and magical powers of precious and semiprecious stones, or *De Natura Fossilium* by the Georgius Agricola (17th century) nicknamed the "Father of mineralogy".

Mineralogical terminology shares a portion of terms with other branches of geology as palaeontology, petrology, gemology, etc., with other natural sciences as chemistry and physics, as well as with technological fields as metallurgy and the mining industry. In addition, it comprises an official list of names designating minerals, which are the main object of interest of mineralogists. In contrast to the nomenclatures of zoology (e. g. Selosse 2016), botany (e. g. Sager 1990: 95–96, Gunnarsson 2011, Minelli 2016), chemistry (e. g. Crosland 1978, Sager 1990: 96–97, Zanola 2014: 113–128, Bensaude-Vincent 2016, Humbley 2018: 243–249), and medicine (e. g. Sager 1990: 94–95, Humbley 2018: 249–252), that of mineralogy seems to be less investigated, at least by linguists (cf. Holeš 2024 and Kostylev/Tikhomirova 2024 analysing mineral names derived from proper names of persons). However, its history and rules are described by mineralogists (e. g. Povarennykh 1972: 83–92, Mitchell 1979, Nickel/Grice 1998, Hatert et al. 2013, 2023, Fourestier 2002).

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This article focuses on the recently added items in the mineralogical nomenclature. Fourestier (2002: 1722) states that in the past, minerals were usually named by the person who found them, and the descriptions varied greatly according to the skill of the discoverer, the political climate, the place of residence, the language, etc. The mineralogical literature was, therefore, full of "superfluous, erroneous or fanciful names" until the late 1950s, when the International Mineralogical Association (IMA) was founded in Madrid (1958) and the Commission on New Minerals, Nomenclature and Classification (CNMNC) was established as one of the IMA original eight commissions (1959) (Fourestier 2002: 1721 f.). Contemporary mineralogical nomenclature includes mineral names formed by prefixation, suffixation, names describing physical and chemical properties of minerals as colour, form of crystals and chemical composition, and, in particular, names based on proper names of persons and places constituting the most important source of new mineral names.

2 Main features of the mineralogical nomenclature

Bozděchová (2017) defines the nomenclature as a set of terms arranged according to a certain classification principle, and Kocourek (1982: 78) explains the term nomenclature as follows:

> For many, the terminology is a set of units designating (abstract) notions of a science, while nomenclature is a set of names for concrete "things", plants, animals, chemical compounds. […] For us and for most terminologists, the terminology in the broad sense includes both, terminology in the narrow sense and the nomenclature.[1]

Sager (1990: 90 f.) remarks that "scientific disciplines concerned with the observation and description of a large number of natural phenomena", such as biological sciences, geology, including mineralogy, chemistry, and medicine, have a "fundamental need" to order and classify individual objects that have to be unambiguously identified. Laudan (1987) explains that the classification of minerals obsessed generations of scientists and new classifications abounded in the history. In one of the most famous, Carl Linnaeus applied the taxonomic principles he had used for plant and animal kingdoms. He wanted to show that minerals can be treated in the same way as plants and animals and proposed to classify crystalline minerals by counting their various faces and according to their reactions to heat and water. Linnaeus set up a complete hierarchy of mineral kinds, ranging from orders down to classes, genera, species, and varieties (Laudan 1987: 73–75). Even if his proposal has fallen into oblivion and has never been adopted, it surely represents an interesting chapter in the history of mineralogy and terminology of the 18th century. Modern systems of mineral classification were proposed by Hugo Strunz (1941), who introduced chemical classification of minerals into 10 classes (elements, sulphides, halides, oxides, … organic compounds), subdivided into divisions, families, and groups according to their chemical composition and crystal structure. Aleksandr Sergeevich Povarennykh (1972) proposed to rename all minerals, since he considered their names irrational, suggesting that minerals maintain a one-word name, containing the suffix *-ite* and the root reflecting chemical composition and crystallography of the mineral (Fourestier 2002: 1722).

[1] Original: « La terminologie est, pour beaucoup, l'ensemble des unités désignant les notions (abstraites) d'une science, alors que la nomenclature est l'ensemble des noms des « choses » concrètes, plantes, animaux, composés chimiques. […] Pour nous et pour la plupart des terminologues, la terminologie au sens large inclut aussi bien la terminologie au sens étroit que la nomenclature. » (Author's translation).

The "official" and regularly updated list of minerals published on the website of the CNMNC of the IMA[2] included 5975 minerals at the time of this manuscript (September 2023). The list comprises minerals with several statuses: (a) names approved after the establishment of the IMA in 1958, (b) grandfathered minerals discovered before the birth of the IMA, (c) minerals that were redefined during the IMA era, (d) minerals that were renamed during the IMA era, and (e) poorly characterised minerals of doubtful validity (IMA 2023).

Rules presiding the creation of new minerals names were formulated by Nickel/Grice (1998: 10 f.) and some of them can be resumed as follows. The author of the original description is responsible for the choice of a new mineral name, but the name must be approved by the CNMNC. Minerals are named after the geographical locality of their occurrence, after their discoverer, after a person prominent in the field of mineralogy, or after a particular property of the mineral. The naming of minerals after commercial organisations or groups without specific contributions to mineralogy is discouraged. If the mineral is to be named after a locality, the spelling should conform to that in use at the locality. If it is to be named after a living person, that person should express their consent prior to submission of the proposal to the CNMNC. Several rules concern the spelling: the mineral name should omit a space or a capital letter in the name of the person (e. g. *mcnearite*, not *mcNearite*), the original spelling of the person's name should be retained, other than Latin scripts should be transliterated, diacritical marks should be retained wherever possible, etc.

These general guidelines are further detailed for use of elements called *brachygraphic signs* by Kocourek (1982: 72), including letters, numbers, and special signs, as well as prefixes and suffixes serving for distinction of similar and related minerals.[3] These guidelines are followed for newly described minerals, but they are not applied to grandfathered species with well-established names which should be preserved. In case a species is shown as invalid, a renaming, redefinition or discreditation procedure is commenced by the CNMNC (Hatert et al. 2013: 115).

Motivations of mineral names newly adopted and approved by the CNMNC are resumed by Hatert et al. (2013: 113). According to the authors, the name may reflect:

- morphology of the mineral (e. g. *tetrahedrite* in allusion to the tetrahedral crystal shape);
- its colour (e. g. *hematite* < Greek *haima* 'blood', according to its characteristic colour);
- its chemical composition (e. g. *uraninite* < *uranium*);
- its physical properties (e. g. *barite* < Greek *barys* 'heavy', in allusion to its high specific gravity);
- its use (e. g. *graphite* < Greek *graphein* 'to write');
- its similarity to biological objects (e. g. *malachite* < Greek *malakhe* 'mallows' in allusion to the green colour of the leaves);
- its structural features (e. g. *clinoenstatite*, for its monoclinic crystal system and chemical identity with enstatite);

[2] International Mineralogical Association (IMA), founded in 1958, is the world's largest organisation promoting mineralogy, involving 38 national mineralogical societies or groups. It has several committees (including the CNMNC) and working groups and awards an annual medal of excellence in mineralogical sciences (IMA 2023).

[3] In line with mineralogical literature, the terms *prefix* and *suffix* are used here even where some linguists would speak about composition (*manganoschafarzikite*, *gysinite-(La)*).

- its type locality or another geographical name (e. g. *andalusite* < Spanish region of Andalusia);
- first or family name or both of outstanding personalities (e. g. *goethite* < Johann Wolfgang von Goethe, German writer and philosopher, or *nielsbohrite* < Niels Hendrik David Bohr, Danish physicist);
- mythological figures (e. g. *aegirine* < Ægir, Scandinavian sea-god, mineral being first described from Norway).

Of course, the above list is not exhaustive and other etymologies come to mind, as

- intricate metaphors describing other mineral properties (e. g. *sphalerite*, from the Greek *sphaleros* 'treacherous', because the mineral was mistaken for galena but yielded no lead, or *mimetite* from the Greek *mimetes* 'imitator', as it imitates pyromorphite) (Anthony et al. 2023);
- names after institutions (e. g. *museumite* honouring all museums in the world that preserve their samples with care and accuracy, since this new mineral was an old sample of the mineralogical collection of the Natural History Museum of the University of Florence and was not found *in situ* (Bindi/Cipriani 2004: 835);
- names after professional associations (e. g. *afmite* < *AFM*, Association Française de Microminéralogie, or *sasaite* < *SASA*, South African Speleological Association) and companies (e. g. *amosite* < *AMOS*, Asbestos Mines of South Africa, *lillianite* < Lillian Mining Company) (Mitchell 1979: 38).

The CNMNC guidelines allow enough creativity permitting to construct an interesting hybrid mineralogical nomenclature where eponymic and descriptive names are complemented with prefixes and suffixes (Hatert et al. 2013: 113 f.).

3 Terminological neology

The mineralogical nomenclature is an instance of official terminology, called deliberate by Felber (1984: 98). Cabré (1998: 206) enumerates several features distinguishing terminological neologisms from lexical ones: (a) their necessity arising from the need for a designation and their stability, contrasting with the spontaneity of lexical neologisms, (b) the lack of synonymy distorting communicative efficiency, contrasting with frequent coexistence of lexical neologisms and synonyms, (c) their phrastical nature, opposed to the conciseness of lexical neologisms, (d) their formation on neoclassical languages, opposed to lexical neologisms often "appealing to old and dialectal forms of the language", and (e) their international character, compared to the existence of lexical neologisms confined within a language in which they have been created. Let us add that nomenclatures, as a type of terminology, are specific by a higher degree of systematicity, controlled meaning and usage of word-forming elements, as well as a stronger international harmonisation and unification, including the organised coining of new names on national or international level.

Out of these features, three points are to be underlined in case of the mineralogical nomenclature, namely (a) creation of new designations of minerals formed exactly to fill a gap in the nomenclature, (b) the inadmissibility of synonymy that would contradict the very sense of the nomenclature, and (e) the names being predetermined to become international. The suffix *-ite*, of Greek origin, serves for the formation of names, among others, of minerals and fossils (Rey 2011). It systematically corresponds with a series of suffixes in most Indo-Euro-

pean languages (French and Italian *-ite*, Spanish and Portuguese *-ita*, German, Romanian and Russian *-it*, etc.), increasing the international character of the nomenclature and motivating its semantic transparency, which is highly desirable in the environment of intensive international cooperation (Honová 2020: 16). Monoreferentiality of the names is sometimes perturbated by the presence of variants, mainly graphical, e. g. *barite*/*baryte* or *sulfur*/*sulphur*. Obsolete and new names may coexist for some time beyond the official nomenclature, e. g. *chalybite*/*siderite*. As far as the above point (c) is concerned, the official mineral names are always single words, despite many of them being apparent compounds of various types, possibly complemented with chemical prefixes and suffixes. However, multi-word traditional and popular names of minerals are possible, as *lapis lazuli* or *tiger's eye*. As for point (d), Greco-Latin formants, so typical of the language of natural sciences and medicine, are commonly found in mineral names, but they do not represent the privileged type of word formation. Instead, the nomenclature is predominantly based on metonymies consisting in the use of proper names.

4 Corpus and methods

A sample containing 164 mineral names adopted in 2022–2023 (list ends in March 2023 at the time of this manuscript) was selected for the analysis, excerpted from *Newsletters* 65–72 of the CNMNC of the IMA (Miyawaki et al. 2022a–e, 2023, Bosi et al. 2023a–b). *Newsletters* themselves do not mention etymology of the names, although it is sometimes apparent from the type locality or chemical formula. Etymology may be verified in other mineralogical resources (Mitchell 1979, Anthony et al. 2023 and Hudson Institute for Mineralogy 2023 were particularly useful for this article). In addition, descriptions of new minerals usually contain a sentence or a paragraph explaining the name etymology, which may be very brief or quite exhaustive. Let us see a justification of the name *holubite*, given to honour a person:

> A new sulfosalt mineral species, holubite, ideally $Ag_3Pb_6(Sb_8Bi_3)_{\Sigma 11}S_{24}$, has been found on medieval mine dumps of the Staročeské pásmo Lode of the historic Kutná Hora Ag–Pb–Zn ore district, Central Bohemia, Czech Republic. The mineral is named after Milan Holub (born 1938), a Czech geologist and the author of the crucial modern geological work on geology of the Kutná Hora deposit "The Polymetallic Mineralization of Kutná Hora Ore District" […]. Milan Holub is the author of over 30 publications in the field of mining and economic geology and history of mining with a specialisation in the Kutná Hora ore district. He has cooperated closely with archaeologists who made use of his vast knowledge in the field of medieval mining and metallurgy. The new mineral and its name have been approved by the Commission on New Minerals, Nomenclature and Classification (CNMNC) of the International Mineralogical Association […]. (Pažout et al. 2023)

Detailed etymologies of "older" minerals are also scattered in articles devoted to the history of mineralogy, as a series of articles on the Czech mining locality of Jáchymov and its geological exploration (Veselovský/Ondruš/Horák 1997, Veselovský et al. 2003, Plášil/Škácha/Horák 2014). In the event the etymology was missing in available resources (descriptions of new minerals are published only after the approval of the name by the CNMNC and some have not been yet published at the time of this manuscript), the authors of the names themselves were

addressed.[4] It appears from the analysis that current denominative motivations in mineralogical nomenclature can be roughly divided in the following groups.

5 Analysis of the contemporary mineralogical nomenclature

5.1 Names of persons and groups of people

Names of persons are used to honour outstanding mineralogists, petrologists, geologists, and professors, less often mineral collectors, laboratory technicians, museum curators, dealers, chemists, and other persons for their contribution to the mineralogical research. Names based on other relations are not attested in the corpus, even if they do exist, e. g. *mozartite* < Wolfgang Amadeus Mozart, mineral discovered in the 200th year after the composer's death. Sometimes, a group of anonymous persons may be honoured, as in *philolitithe* from Greek *philos* 'loving' and *lithos* 'stone', dedicated to the organization Friends of Mineralogy, Inc., and all the mineral lovers (Anthony et al. 2023). The corpus contained one instance of the name based on an ethnonym, *cherokeeite* from the Cherokee, who inhabited the area of its type locality. *Cuprocherokeeite* is derived from the same name using a chemical prefix.

Formally, and the most often, mineral names contain surnames (e. g. *bakakinite* < Vladimir Vasilievich Bakakin, Russian crystallographer and chemist; *borzęckiite* < Robert Borzęcki, Polish mineral collector and museologist; *chenowethite* < William L. Chenoweth, American uranium geologist; *ebnerite* < John Ebner, American collector of minerals; *elkinstantonite* < Lindy Elkins-Tanton, American planetary scientist; *hanahanite* < John Hanahan, American professor of geology; *holubite* < Milan Holub, Czech geologist (see above); *kayupovaite* < Maria Mikhailovna Kayupova, Russian mineralogist; *loomisite* < Tom Loomis, American mineral collector and dealer; *okruginite* < Victor Mikhailovich Okrugin, Russian mineralogist; *yeite* < Danian Ye, Chinese mineralogist), or the combination of first names and surnames (*bernardevansite* < Bernard W. Evans, American professor in mineralogy and petrology; *louisfuchsite* < Louis H. Fuchs, American specialist in meteorites; *manuelarossiite* < Manuela Rossi, Italian mineralogist and gemologist; *mikenewite* < Mike New, mineral dealer, owner of Top Gem Minerals, Inc.; *raydemarkite* < Ray DeMark, American mineral collector; *rudolfhermannite* – Rudolf Hermann, German chemist and mineralogist). Sometimes, informal first names are used (*kennygayite* < Kennedy (Kenny) Gay, American geologist; *franksousaite* < Francis (Frank) X. Sousa, American collector of minerals; *jimkrieghite* < James D. Kriegh, American meteorite

[4] Many thanks to the mineralogists, authors of many names mentioned in the article, who helped me ascertain the etymology: Atali Agakhanov (Fersman Mineralogical Museum, Russia), Cristian Biagioni (Università di Pisa, Italy), Jan Cempírek (Masaryk University, Czech Republic), Li Guowu (China University of Geosciences, China), Chris Herd (University of Alberta, Canada), Shyh-Lung Hwang (University of Michigan, USA), Peng Liu (Northwest University, China), Anthony R. Kampf (Natural History Museum, Los Angeles, USA), Daisuke Nishio-Hamane (University of Tokyo, Japan), Xiang-Ping Gu (Central South University, China), Sergey V. Krivovichev and Oleg S. Vereshchagin (St. Petersburg University, Russia), Chi Ma (California Institute of Technology, USA), Juraj Majzlan (Friedrich Schiller University Jena, Germany), Richard Pažout (University of Chemistry and Technology, Czech Republic), Jakub Plášil (Czech Academy of Sciences, Czech Republic), Igor Pekov (Lomonosov State University, Russia), Adam Pieczka (AGH University of Science and Technology, Poland), Jiří Sejkora (National Museum, Prague, Czech Republic), Oliver Tschauner (University of Nevada, USA), Anna Vymazalová (Czech Geological Survey, Czech Republic), and Hexiong Yang (University of Arizona, USA).

hunter). Minerals containing first names of persons only were not found in the corpus, even if they do exist (*adrianite* < Adrian J. Brearley, American mineralogist and cosmochemist; *honzaite* < Jan "Honza" Hloušek, Czech mineralogist and mineral collector). In rare cases, there are more minerals named after a single person, differentiated by prefixes or suffixes, e. g. *hakite-(Fe)*, *hakite-(Zn)*, *hakite-(Cd)* < Jaroslav Hak, Czech geologist and mineralogist, found in the corpus, or *sklodowskite* and *cuprosklodowskite* < Marie Sklodowska-Curie, outside the corpus.

Names from non-Latin scripts are transliterated (e. g. *tzeferisite* < Peter Tzeferis, Director of the Mineral Raw Materials Directorate of the Greek Ministry of Environment and Energy; *ikorskyite* < Serafim Veniaminovich Ikorsky, Russian geologist, mineralogist). Foreign diacritic signs are retained (e. g. *magnéliite* < Arne Magnéli, Swedish chemist; *škáchaite* < Pavel Škácha, curator at Mining Museum in Příbram, Czech Republic).

Personal names contained in root are often complemented with prefixes referring to chemical and structural properties of minerals (e. g. *arsenoveszelyite* < Ágost Veszely, Hungarian mining engineer; *cuprodobrovolskyite* < Vladimir Vitalievich Dolivo-Dobrovolsky, Russian petrologist and chemist; *manganoschafarzikite* < Ferenc Schafarzik, Hungarian mineralogist and engineering geologist; *scandio-winchite* < Howard James Winch, British analytical chemist and mining engineer; *zincochenite* < Tzong Tzy Chen, Canadian mineralogist; *zincorietveldite* < Hugo M. Rietveld, Dutch crystallographer). Prefixes may be multiplied (*ferro-ferri-holmquistite* < Per Johan Holmquist, Swedish petrologist). The same applies to suffixes (e. g. *gysinite-(La)* < Marcel Gysin, Swiss professor of mineralogy; *kalyuzhnyite-(Ce)* < Vasily Avksentievich Kalyuzhny, Russian geologist; *pendevilleite-(Y)* < Jean-Marie Pendeville, Belgian collector of minerals; *tennantite-(Mn)* < Smithson Tennant, English chemist; *wenlanzhangite-(Y)* < Wenlan Zhang, Chinese geologist), which may again be multiplied (*whiteite-(CaMnFe)* < John Sampson White, Jr., American curator of minerals). Prefixes and suffixes can be combined in a single word (e. g. *beryllocordierite-Na* < Louis Antoine Cordier, French mining engineer and geologist; *beryllosachanbińskiite-Na* < Michał Sachanbiński, Polish geologist).

In addition, the corpus contains *ginelfite*, composed of surnames of two persons, Carlo *Gin*i and Francesco Gu*elfi*, technicians of the X-ray laboratory of the Earth Science Department of University of Pisa, the name being intended to recognize the fundamental role played by lab-technicians all around the world in supporting research in mineralogy. Outside the corpus, the nomenclature contains acronymic names based on even more names, e. g. *armalcolite* < Neil A. *Arm*strong, Edwin E. *Al*drin, and Michael *Col*lins, the three astronauts of Apollo 11. The acronym may also contain several parts of a single surname, e. g. *rohaite*, from the name of the Danish mineralogist John *Ro*se-*Ha*nsen.

Four mineral names contained an allusion to mythological creatures and in this case, the metonymy is not honorific. The following names, in the corpus, originate in American, Chinese, and Greek mythologies: *boojumite* < Boojum, legendary creature in Haywood County folklore, mixture of man and beast living in caves and coveting precious gemstones; *changesite-(Y)* < Chang'e, Moon goddess in Chinese mythology, the mineral being found in Beijing from lunar surface samples; *nioboixiolite-(Mn2+)* and *nioboixiolite-(□)* < Ixion, Greek mythological king bound on a fiery wheel in Tartaros, inhabited also by Tantalus, in allusion to the mineral's relation to *tantalite*. In total 102 names containing a name of person were identified in the corpus, i. e. 62 % of the mineral names adopted during the given period.

The eponyms, which are largely used in the mineralogical nomenclature, are sometimes criticised by terminologists in other fields. In medicine, Bozděchová (2009: 102 f.) remarks that

such terms are sometimes factually incorrect because they do not always represent the true pioneer or discoverer and continue to be used without respect to the state-of-the-art knowledge in the field. In addition, Humbley (2018: 183) underlines the multiplicity of motivations of such terms, which may be based not only on the name of the researcher who discovered the disease, but also on the biblical, mythological, historical, literary names and even the names of famous patients. Let us add that in the nomenclatures of natural sciences, certain names reflect past social values and tastes and may arouse controverse, as the extinct ichthyosaur *Leninia stellans* commemorating Vladimir Lenin, and the blind beetle *Anophthalmus hitleri* honouring Adolf Hitler, living in certain Slovenian caves and endangered by the collectors of Nazi militaria. Despite various arguments, both names persist in the official paleontological and zoological nomenclatures.

The mineralogical nomenclature seems to be less prone to the inconsistent assessment of history, although it also became target of criticism. Let us recall the words of the renowned mineralogist Povarennykh (1972), mentioned above for his proposal of crystal chemical classification of minerals, criticising the naming of minerals to honour various persons:

> […] this method of naming can be understood when the financing of science was almost entirely dependent on the generosity of aristocrats as in feudal Germany or Russia; but with the loss of this cause the principle became modified, names being given after scientists, mainly mineralogists and chemists. Gradually and imperceptibly this irrational principle gained the upper hand and became traditional; now over half of all minerals bear empty irrational names without relation to their nature, and which are mere dead weight on memory. This impairs free thinking in mineralogy, because the name is often unrelated to the composition or chemical class. For this reason even leading mineralogists are forced regularly to use mineralogical dictionaries. (Povarennykh 1972: 84)

5.2 Names of localities (toponyms)

Place names include

- mines (e. g. *bounahasite* < Bou Nahas Mine, Morocco; *driekopite* < Driekop mine, South Africa; *tomsquarryite* < Tom's quarry, Australia; *wortupaite* < Wortupa gold mine, Australia),
- villages (e. g. *vielleaureite-(Ce)* < Vielle-Aure, France; *vrančiceite* < Vrančice, Czech Republic),
- towns and cities (e. g. *arsenogoldfieldite* < Goldfield, USA; *napoliite* < Naples, Italy),
- administrative areas (e. g. *gunmaite* < Gunma Prefecture, Japan; *haywoodite* < Haywood County, USA; *manganrockbridgeite* < Rockbridge County, USA),

and natural objects, as

- mountains (e. g. *ermeloite* < Ermelo, Spain; *montpelvouxite* < Mont *Pelvoux*, France),
- geological formations (*chinleite-(Nd)* < Chinle Formation, USA; *shinarumpite* < Shinarump formation, USA),
- islands (*hokkaidoite* < Hokkaido, Japan),
- creeks and rivers (*finescreekite* < Fines Creek, USA; *amgaite* < Amga, Russia),
- and even meteorites (*elaliite* < El Ali meteorite, Somalia).

Outside the corpus, other types are possible, containing names of states, countries, historical provinces, geological deposits, mountain ranges, volcanoes, and even of extraterrestrial localities (*tranquillityite* < Sea of Tranquillity, Moon, Apollo 11 landing site). The names usually refer to the localities where the mineral was first discovered, but other relations occur, and minerals may also be named after seats of university or laboratory where they were described. In *tartarosite*, the place is taken from Greek mythology in which Tartaros is a mythological abyss where Titans were imprisoned. The name was used in allusion to the great depth and extreme conditions in which mineral formed. In the corpus, this is probably the only case of the metonymy not based on a relation between the place of discovery and the mineral name.

Names from non-Latin scripts are transliterated (*mizraite-(Ce)* < village of Mizra, Israel; *selsurtite* < Selsurt mountain, Russia; *wodegongjieite* < Wode Gongjie mountain, China, etc). Foreign diacritic signs are retained (e. g. *vrančiceite*, *arsenoústalečite*, *zvěstovite-(Fe)*).

Prefixes and suffixes referring to chemical properties may be combined with place names (e. g. *arsenoústalečite* < Ústaleč, Czech Republic; *manganrockbridgeite* < Rockbridge County, USA; *chinleite-(Nd)* < Chinle Formation, USA; *vielleaureite-(Ce)* < Vielle-Aure, France; *zvěstovite-(Fe)* < Zvěstov, Czech Republic). Prefixes and suffixes can be used in a single word (*oxyytrobetafite-(Y)* < Betafo, Madagascar).

Formation from toponyms is very popular and flexible (e. g. *staročeskéite*, after the Staročeské pásmo lode in Czech Republic, based on the adjectival part of the original compound proper name of locality). Sometimes, the toponym itself is not used any longer, but it remains preserved in the mineral name, as in *ezochiite*, in our corpus, < Ezochi, older name of the island of Hokkaido (cf. names outside the corpus, as *leningradite* < *Leningrad*, now *St. Petersburg*, or *mutinaite* < Mutina, ancient Latin name of Modena). In total 39 names containing a place name were identified in the corpus, i. e. 24 % of the mineral names adopted in course of the studied period.

5.3 Names based on chemical and structural properties

Surprisingly, names based on chemical and structural properties of minerals are rarer than expected in the current mineralogical nomenclature, even if they are not uncommon. They include several types of compound and derived names, as *tetrahedrite-(Mn)*, in which the suffix indicates chemical composition and the root the tetrahedral form of crystals, *hexathioplumbite*, hexagonal thiosulfate of lead, *nickelalumite*, containing nickel and aluminium, *auroselenide*, containing gold and selenium, etc. Mineral names based on acronyms depicting chemical composition seem to be an original mineralogical solution, e. g. *nafeasite*, named for the composition, including *na*trium, *fe*rrum, and arsenic (*As*), and *carbocalumite*, named for *carbo*nium, *cal*cium, and *alum*inium. Sometimes, they include words other than chemical elements, as *nacareniobsite-(Y)* for *na*trium, *ca*lcium, *r*are *e*arths and *niob*ium, and in some cases, they may be even more inventive, as *fluorsigaiite*, for *fluor*ine, *si* as the Chinese pronunciation of strontium, and *gai* as the Chinese pronunciation of calcium.

The brachygraphic signs complementing the names may further describe the mineral features (Mitchell 1979: 71–75, Hatert et al. 2013, 2023). In general, they include Greek symbols (*domeykite-β*, *uranophane-α*), Roman numerals (*nováčekite-I*, *nováčekite-II*), and chemical symbols (*bastnäsite-(Nd)*, *labuntsovite-Fe*), which may be multiplied (*jahnsite-(MnMnFe)*). All of them are used to distinguish separate mineral species having the same composition and different crystal structures or presenting structural analogies with significant chemical varia-

tions. In addition, a series of prefixes is used in the nomenclature, designating, e. g., different crystal systems, as *cubo-* (cubic), *hexa-* (hexagonal), *tetra-* (tetragonal), *trigo-* (trigonal), etc. Prefixes also refer to chemical, morphological, and physical features of minerals, e. g. *hexahydrite* (six H_2O molecules in the formula) and *clinohedrite* (inclined faces of the crystals). The prefix *para-* may designate polymorphs (*paraberzeliite*, *parabrandtite*), *pseudo-* designates polymorphs with a different crystal system showing a pseudosymmetry, etc. A maximum of three chemical suffixes and prefixes is allowed.

Only 19 names of this type were identified in the corpus, i. e. 12 % of the total. However, many minerals based on personal and place names would also partly belong to this group, since they sometimes contain prefixes and suffixes designating chemical and physical properties, e. g. *kenorozhdestvenskayaite-(Fe)* in which the root honours the Russian mineralogist Irina Rozhdestvenskaya, whereas the prefix *keno* and suffix *Fe* indicate vacancy at the S(2) site and the dominant C constituent, respectively.

5.4 Figurative names alluding to colours, objects, and other mineral properties

Before the development of chemistry in the 18th century and X-ray diffraction in the 20th century, physical properties such as colour, lustre, hardness, and shape were often the first and the only features people could note in new minerals (Hatert et al. 2013: 113). Let us compare a series of mineral names containing Greek *khrysos* 'gold-coloured': *chrysotile*, *chrysocolla*, *chrysolite*, *chrysoberyl*, *chrysothallite*, etc. Such names are usually drawn from classical languages (e. g. *leucite* and *albite* from Greek *leukos* and Latin *albus*, both meaning 'white'), but this is not a rule (e. g. *eztlite* formed on the Nahua word for 'blood' and *azurite* from the Persian word for 'blue') (Anthony et al. 2023). In the current nomenclature, however, this type seems to be quite rare, and the only chromatic name in the sample is *asagiite*, from Japanese *asagi-iro* 'light blue'.

In two cases, shape metaphors are used to form a new mineral name: *hayelasdiite*, which is based on the Cherokee word *hayelasdi* 'blade', in allusion to blade-like form of the mineral and the locality, which was inhabited by the Indian tribe, and *calcioancylite-(La)*, from Greek *ankylos* 'curved', with a root referring to its rounded distorted crystals and a prefix and a suffix referring to its chemical composition (Hudson Institute for Mineralogy 2023).

In some cases, other metaphors are used in reference to distinctive properties of newly discovered minerals, e. g. *monazite-(Gd)* from Greek *monazeis* 'solitary' in allusion to its rarity in the first localities. The same principle applies to the newly adopted mineral *magnesio-ferri-hornblende*, the root of which is an ancient geological name composed from an old German *horn* and *blende* 'deceive', since the material did not contain any valuable metal.

Description of the mineral appearance is a means commonly used in trivial names of stones, which are often mere varieties of minerals not included in the IMA list. Colour etymology can be found in *emerald*, *aquamarine*, and *heliodor*, green, blue, and yellow varieties of beryl. *Tiger's eye* is one of the most common names, in which the zoological metaphor is used to depict the stone chatoyance due to its fibrous structure. A parallel metaphor is found across languages, usually resulting from calquing (Kocourek 1982: 148) (cf. French *œil-de-tigre*, German *Tigerauge*, Spanish *ojo de tigre*, Russian *tigrovyj glaz*, etc.). According to Guiraud, popular taxonomies often use parts of animal body, as the author demonstrated on French folk names of plants (Guiraud 1967: 155–171). These metaphors are also used in English trivial denominations of stones as *cat's eye*, *tiger's eye*, *falcon's eye*, *dragon's eye*, etc.

The role of metaphors as a terminogenic process has been acknowledged since long. Ullmann (1972: 212), for whom the metaphor results from "similarity of senses", underlines its creative force in the language and distinguishes its four major types (anthropomorphic and animal metaphors, shifts from concrete to abstract, and synaesthetic metaphors) (Ullmann 1972: 212–218), out of which, as we have seen above, the second type recurrently appears in popular names of minerals. In the official nomenclature, however, they are exceptional, identified only in a couple of the aforementioned names which represent 2 % of the sample from 2022–2023.

6 Conclusion

The mineralogical nomenclature established and regularly updated since 1958, year of the IMA foundation, represents an interesting hybrid, consisting of names formed by prefixation, suffixation, descriptive names and names based on metonymies. The analysis of a sample of 164 mineral names, adopted by the CNMNC from January 2022 to March 2023, showed that the motivations of new mineral names can be divided into the following groups: (a) metonymies based on names of persons, (b) metonymies based on names of places, (c) descriptive names based on chemical and structural features, and (d) figurative names alluding to colours, objects, and other mineral properties. In terms of their frequency, we may conclude that:

- despite objections formulated by terminologists and some mineralogists themselves, mineralogical nomenclature remains predominantly based on proper names of persons and places, representing respectively 62 % and 24 % of cases;
- other types of names, as names referring to chemical and structural properties of minerals, are relatively rare (12 %); however, this group would be much larger if the names containing suffixes and prefixes are added;
- metaphors, popular in the past, are relatively rarely used to form new names of minerals, although they are very frequent in trivial names of minerals.

In conclusion, we may state that the mineralogical nomenclature more than confirms Benveniste's words (1974: 247) pronounced in connection with the term *scientific*:

> In any science, constituting its own terminology marks the advent or development of a new conceptualisation, and it thereby signals a decisive moment in its history. We could even say that the history proper of a science can be summed up in that of its own terms.[5]

[5] Original: « La constitution d'une terminologie propre marque dans toute science l'avènement ou le développement d'une conceptualisation nouvelle, et par là elle signale un moment décisif de son histoire. On pourrait même dire que l'histoire propre d'une science se résume en celle de ses termes propres. » (Author's translation).

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